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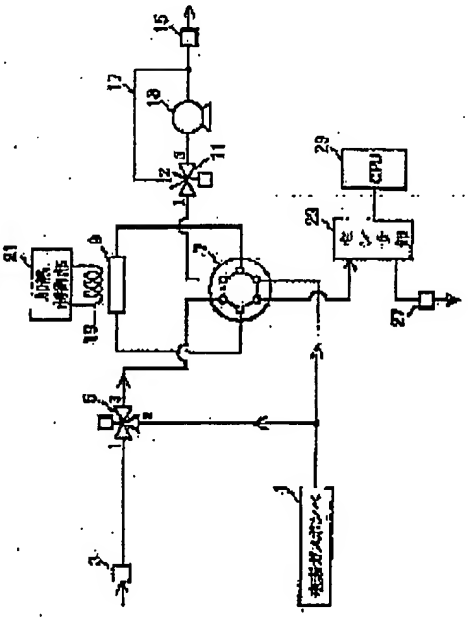
(54) ODOR MEASURING APPARATUS

(57)Abstract:
PROBLEM TO BE SOLVED: To measure an odor component in a sample gas by using a proper moisture amount.
SOLUTION: A six-way rotary valve 7 is set in solid-line positions. A valve 5 is connected to a 1-3 side. A valve 11 is connected to a 1-3 side. A pump 13 is operated. A sample gas is sucked to a collection pipe 9. An odor component and moisture are collected in the collection pipe 9. Then, the valve 5 is changed over to a 2-3 side. The valve 11 is changed over to a 1-2 side. The introduction time of nitrogen gas is adjusted by a CPU 29 so as to be introduced to the collection pipe 9. A moisture amount inside the collection pipe 9 is adjusted. Then, the six-way rotary valve 7 is changed over to broken-line positions. A heater 19 is heated by a heating control part 21. The odor component and the moisture are thermally desorbed from an adsorbent in the collection pipe 9. The nitrogen gas is supplied to the collection pipe 9 by a nitrogen gas cylinder 1. The odor component is driven out from the collection pipe 9 so as to be sent to a sensor part 23.



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CLAIMS

[Claim(s)]
[Claim 1]One or more gas sensors.
A capturing part which it fills up with a scavenger which adsorbs a smell ingredient in sample gas, is desorbed after adsorbing a smell ingredient, and is led to said gas sensor.
A dry gas feed zone which supplies a dry gas to a capturing part.
it had the above — it is a smell measuring device and stuck to said capturing part — before desorbing a smell ingredient, it had a control section which adjusts time to supply a dry gas to said capturing part, desorbs a part of moisture which smells in said capturing part and is caught with an ingredient, and adjusts a moisture content

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention is followed for having had the capturing part which it fills up with the scavenger which adsorbs one or more gas sensors and the smell ingredient in sample gas, is desorbed after adsorbing a smell ingredient, and is led to a gas sensor, and the dry gas feed zone which supplies a dry gas to a capturing part, and relates to a measuring device. In fields, such as management of deodorization, aroma, and foodstuffs, and measurement of an offensive odor, such a smell measuring device is used in order to identify or identify a smell.
[0002]
[Description of the Prior Art]As a gas sensor, there are a metal oxide semiconductor sensor, a conductive polymer sensor, a sensor in which the gas adsorption film was formed on the surface of a crystal oscillator or a SAW (Surface Acoustic Wave: surface acoustic waves) device, etc. In the gas sensor using a metal oxide semiconductor, the phenomenon in which the electrical resistance of an oxide semiconductor changes with the oxidation-reduction reactions of the smell ingredient in sample gas is used. In the gas sensor using a conductive polymer, the phenomenon in which the conductivity of a conductive polymer changes with adsorption of a smell ingredient is used. In the sensor in which the gas adsorption film was formed on the surface of a crystal oscillator or a SAW device, the phenomenon in which pitch changes in connection with the weight change by adsorption of a smell ingredient on a gas adsorption film is used.
[0003]the smell ingredient in sample gas is measured using such a phenomenon -- the smell measuring device is provided with two or more gas sensors with which the response characteristics over one or a smell ingredient differ.
The art called what is called chemometrics (chemical Measurement Law) of having displayed the detecting signal from a gas sensor as it is, or bringing the detecting signal of two or more gas sensors to a multivariate analysis was applied, and the smell ingredient in sample gas is measured.

[0004]
[Problem(s) to be Solved by the Invention]However, it takes using the above-mentioned gas sensor, and since the sensitivity of a measuring device to moisture (humidity) is generally large and the humidity influence by measuring atmospheres is greater than a smell ingredient, there is a fault that measurement reproducibility is low. Therefore, the odorless gas of fixed humidity was supplied as carrier gas, and the method of lowering the influence of the moisture in sample gas relatively, or making it dry etc., once it catches sample gas by a scavenger is taken.
[0005]However, on the other hand, . It is reported that how to feel a smell has a close relation to a moisture content. (It adheres to 153-156-1998, a before [a Society of Heating, Air-conditioning & Sanitary Engineers of Japan scientific public performance meeting] ** collection, and "air-conditioner besides" Norio Shimizu about the relation

between "humidity and a smell smell" Smelling with the Japanese taste besides Shigeyuki Sato an academic journal, 5 (3) 311-314, 1998). Therefore, if it takes for having caught, an ingredient is dried thoroughly and the influence of moisture is made completely lost, the problem of it becoming impossible to take correlation with human being's organic functions will arise.

[0006]In the method of using the carrier gas of fixed humidity, since it is difficult to smell to the moisture in carrier gas, and for the output of an ingredient to become small relatively, and to keep the moisture in carrier gas constant further, there is a fault that the influence by humidity fluctuation becomes large and S/N becomes small. Then, an object of this invention is to provide the smell measuring device which can measure the smell ingredient in sample gas with a suitable moisture content.

[0007]

[Means for Solving the Problem]That this invention is characterized by that comprises the following.

One or more gas sensors.

A capturing part which it fills up with a scavenger which adsorbs a smell ingredient in sample gas, is desorbed after adsorbing a smell ingredient, and is led to a gas sensor.

A dry gas feed zone which supplies a dry gas to a capturing part.

it had — it is a smell measuring device and stuck to a capturing part — a control section which adjusts time to supply a dry gas to a capturing part, desorbs a part of moisture which smells in a capturing part and is caught with an ingredient, and adjusts a moisture content before desorbing a smell ingredient.

[0008]After catching a smell ingredient in sample gas to a capturing part, a dry gas feed zone is controlled by a control section, and a dry gas is supplied to a capturing part. By adjusting the dry gas feed time by a control section, a moisture content which stuck to a scavenger with a smell ingredient is made small by a certain fixed ratio. Then, it takes for having stuck to a scavenger, an ingredient and moisture are desorbed, and it leads to a gas sensor. Thus, by adjusting a moisture content from which it smells and is desorbed simultaneously with an ingredient, a smell ingredient in sample gas can be measured with a suitable moisture content.

[0009]

[Example]Drawing 1 is an outline lineblock diagram showing one example of this invention. As a gas supply source, it has the nitrogen gas bomb 1. Nitrogen gas is used as zero gas, a dry gas, or carrier gas. The sample suction opening 3 which introduces sample gas is connected to the three-way-type electro-magnetic valve 5. The nitrogen gas bomb 1 is also connected to the valve 5, and the valve 5 switches a channel suitably and sends sample gas or nitrogen gas to one port of the roppo rotary valve 7.

[0010]It is connected to the capturing tubes (capturing part) 9 provided with the adsorbent which adsorbs a smell ingredient, and the channel from the valve 5 is connected to one port of the three-way-type electro-magnetic valve 11 at the time of the position of a dashed line, when the roppo rotary valve 7 is a position of a solid line.The channel connected with the gas exhaust 15 via the pump 13 and the bypass passage 17 connected with the gas exhaust 15 without passing the pump 13 are also connected to the valve 11. The valve 11 switches a channel suitably and connects one port of the roppo rotary valve 7 to the pump 13 or the bypass passage 17.

The pump 13 attracts sample gas at the time of sample gas suction, and discharges it from the gas exhaust 15. The circumference of the capturing tubes 9 is equipped with the heater 19, and the heater 19 is electrically connected to the heating control part 21 which controls the temperature of the capturing tubes 9.

[0011]Direct continuation of the nitrogen gas bomb 1 is carried out also to one port of the roppo rotary valve 7.

When the roppo rotary valve 7 is a position of a dashed line, it is connected to the sensor part 23 via the capturing tubes 9, and nitrogen gas is supplied as carrier gas.

When the roppo rotary valve 7 is a position of a solid line, it is connected to the sensor part 23, without passing the capturing tubes 9, and nitrogen gas is supplied to the sensor part 23 as zero gas. The sensor part 23 is provided with two or more smell sensors by which gas response characteristics differ, such as a conductive polymer sensor and a metal oxide semiconductor sensor. The sensor part 23 is equipped with the heater which controls the temperature of a smell sensor. The outlet side of the sensor part 23 is connected to the gas exhaust 27.

[0012]The detecting signal of each gas sensor of the sensor part 23 is sent to CPU29 via an A/D converter (graphic display abbreviation). The valves 5 and 11, the roppo rotary valve 7, the pump 13, and the heating control part 21 have operation controlled by CPU29. In this example, although the graphic display is omitted, the mechanism in which the pressure and flow of the nitrogen gas supplied from the nitrogen gas bomb 1 are adjusted is arranged at the suitable position of the channel. When using a metal oxide semiconductor sensor as a smell sensor, an oxygen supply is arranged at a suitable position, but the graphic display is omitted. The control section which the dry gas feed zone which constitutes this invention is constituted by the nitrogen gas bomb 1, the valve 5, and the roppo rotary valve 7, and constitutes this invention is realized by CPU29.

[0013]Next, operation of this example is explained.

(Zero gas measurement) The roppo rotary valve 7 is made into the position of a solid line, from the nitrogen gas bomb 1, nitrogen gas is supplied via the roppo rotary valve 7, and the sensor part 23 is supplied. The detecting signal (sensor resistance) of the smell sensor at that time is sent to CPU29, and it memorizes as the sensor resistance Rb at the time of zero gas measurement. At this time, the valve 5 is connected to 2-3 side, the nitrogen gas bomb 1 is connected to the capturing tubes 9 via the valve 5 and the roppo rotary valve 7, the valve 11 is connected to 1-2 side, and the capturing tubes 9 are connected to the gas exhaust 15 via the roppo rotary valve 7, the valve 11, and the bypass passage 17. Thereby, from the nitrogen gas bomb 1, nitrogen gas is supplied to the capturing tubes 9 via the valve 5 and the roppo rotary valve 7, the nitrogen gas is discharged from the gas exhaust 15 via the roppo rotary valve 7, the valve 11, and the bypass passage 17, and the capturing tubes 9 are cleaned.

[0014](Suction of sample gas) The valve 5 is connected to 1-3 side for the roppo rotary valve 7 with the position of a solid line, the sample suction opening 3 is connected to the capturing tubes 9, the valve 11 is connected to 1-3 side, and the capturing tubes 9 are connected to the pump 13. The pump 13 is operated, sample gas is attracted to the capturing tubes 9 by a predetermined sampling flow and sampling time, only the volume of the specified quantity passes the capturing tubes 9 for sample gas, and the smell ingredient in sample gas is caught to the capturing tubes 9. The moisture in sample gas is also caught by the capturing tubes 9 at this time.

[0015](Moisture content regulation in capturing tubes) The roppo rotary valve 7 after sample catching With a real line position; The valve 5 is switched to 2-3 side, the nitrogen gas bomb 1 is connected to the capturing tubes 9 via the valve 5 and the roppo rotary valve 7, the valve 11 is switched to 1-2 side, and the capturing tubes 9 are connected to the gas exhaust 15 via the roppo rotary valve 7, the valve 11, and the bypass passage 17. And the installation time (drying time) of nitrogen gas is adjusted by CPU29, nitrogen gas is introduced into the capturing tubes 9, and the moisture content in the capturing tubes 9 is adjusted.

[0016](Concentration of a smell ingredient) The roppo rotary valve 7 is switched to a dashed line position, the capturing tubes 9 are connected with the nitrogen gas bomb 1, and the sensor part 23 is connected with the capturing tubes 9. The heater 19 is heated by the heating control part 21, the capturing tubes 9 are heated rapidly, it takes for having stuck to the adsorbent of the capturing tubes 9, and thermal desorption of an ingredient and the moisture is carried out from adsorbent. The nitrogen gas of the specified quantity is supplied to the capturing tubes 9 with the nitrogen gas bomb 1, it smells from the capturing tubes 9, an ingredient is driven out, and it sends to the sensor part 23. When the

volume of the nitrogen gas used for dismissal is smaller than the volume of the sample gas which caught the smell ingredient at this time, it means that sample gas was condensed and the high sensitivity measurement of it becomes possible. When the volume of the nitrogen gas is conversely larger, since it means that it diluted, sample gas can measure the sample gas containing a high-concentration smell ingredient.

[0017](Detection of a smell ingredient) It was sent to the sensor part 23, and it smells, two or more gas sensors detect an ingredient, respectively, and the sensor resistance Rs is sent to CPU29. Those measurement results are applied to a multivariate analysis, and a smell is identified.

[0018](Cleaning) after ending heating of the capturing tubes 9 with the heater 19, the temperature of the sensor part 23 was raised, and it smelled, and adhered on the surface of the sensor — a smell ingredient is desorbed. Supplying nitrogen gas is continued from the nitrogen gas bomb 1, and the gas dismissal in the sensor part 23 and cleaning of a smell sensor are performed.

[0019]Drawing 2 is a graph with which a measurement result when changing drying time about the same sample gas is expressed using this example. Here, the metal oxide semiconductor sensor was used as a smell sensor. A vertical axis expresses a sensor output (log (Rs/Rb)), and a horizontal axis expresses time (second). As sample gas, what added water to the butyl acetate gas whose concentration is 20 ppm, and was used as saturated steam was used. In order to compare, moisture concentration is hundreds of ppb and the butyl acetate gas (dry sample) whose concentration is 20 ppm was also used. not performing introduction of nitrogen gas, after smelling in the capturing tubes 9 and catching an ingredient about the sample gas of saturated steam (with no desiccation) — or introduction of nitrogen gas — for 10 seconds, for 60 seconds, and for 90 seconds — or it carried out for 120 seconds. About the dry sample, it smelled in the capturing tubes 9 and the ingredient was caught. And heating was started with the heater 19 120 seconds after after catching of a smell ingredient.

[0020]As shown in drawing 2, the sensor output by moisture has appeared about data (solid line) without desiccation, and the data (dashed line) of 10-second desiccation (refer to the portion surrounded with the ellipse in a figure). Although the data of 60-second desiccation, the data of 90-second desiccation, the data of 120 desiccation, and the data of a dry sample lap mostly, and are displayed and the peak position of the sensor output is also the almost same position, About data without desiccation, and the data of 10-second desiccation, the peak position is displayed on a position different, respectively. Thus, by changing drying time shows that a sensor output waveform and a peak position are controllable.

[0021]The measurement result of two or more smell sensors is applied to principal component analysis, two-dimensional compression processing is carried out, and there is the method of plotting on a smell map. In the method, a smell map is created as follows, for example. For example, supposing it obtains the output of one piece from each sensor using six sensors, it can be considered that each measurement data point is a 6-dimensional vector. In that case, the 2nd axis of the main ingredients is taken in the direction in which each measurement data point of being dotted on 6-dimensional space takes the 1st axis of the main ingredients in the direction which varies most, and intersects perpendicularly with it, and each measurement data point differs most again, and each measurement data point is projected on the flat surface made with the 1st axis of the main ingredients, and the 2nd axis. And what was obtained is a smell map.

[0022]Drawing 3 is a smell map at the time of conducting principal component analysis using this example. As sample gas, dry butyl acetate gas, the butyl acetate gas of a saturated steam state, dry butanol gas, and the butanol gas of a saturated steam state were used. About the sample gas of a saturated steam state, after smelling in capturing tubes and catching an ingredient, the drying process by nitrogen gas was performed in time of either for 5 seconds, for 10 seconds or a for [60 seconds].

[0023]As shown in drawing 3, about both butyl acetate and butanol. Although the plot

position of sample gas dry with desiccation for 60 seconds which removed the moisture in sample gas thoroughly turns into the same position and the difference of humidity does not appear, the plot position of 5-second desiccation and 10-second desiccation with imperfect removal of moisture turns into a different position. When not performing a drying process, it is thought that the difference of humidity becomes more dominant than the difference of the quality of sample gas. Since it is such, if the moisture content of sample gas is not adjusted, it turns out that it cannot be said that the smell is identified. If it takes for having caught, an ingredient is dried thoroughly and the influence of moisture is made completely lost, it will become impossible however, to take correlation with organic functions. Then, discernment nearer to human being can be performed to a smell by taking for having caught, controlling the drying time of an ingredient by this example, and measuring the smell ingredient in sample gas with a suitable moisture content.

[0024]Although the moisture content is adjusted by controlling drying time in this example, it can take for becoming dominant in a sensor response depending on the response characteristic of a gas sensor, and the catching characteristic of capturing tubes, and an ingredient can also be removed to some extent. For example, when the thing of a carbon system is used as a scavenger, using a metal oxide semiconductor sensor as a smell sensor, Since the ingredient which becomes dominant [hydrogen sulfide without carbon, alcohol with a small carbon number, etc.] in a sensor response is hard to be caught, it can suppress those influences and can also detect other ingredients.

[0025]Although this invention was followed using the metal oxide semiconductor sensor and applied to the measuring device in this example, This invention is not limited to this, can be followed using a conductive polymer sensor or the sensor in which the gas adsorption film was formed on the surface of a crystal oscillator or a SAW device, and can be applied also to a measuring device. Although it has one capturing tubes as a capturing part in this example, it may have two or more capturing tubes from which the catching characteristic differs.

[0026]

[Effect of the Invention]Since time to supply a dry gas to a capturing part is adjusted by a control section in the smell measuring device of this invention and the moisture content from which it was caught by the capturing part, smells, and is desorbed simultaneously with an ingredient was adjusted, The smell ingredient in sample gas can be measured with a suitable moisture content, and the sensitivity characteristic over the moisture of a gas sensor can also be brought close to human being's organic functions.

[Translation done.]